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Title

Use and Benefits of Fenamiphos on Pineapple in Hawaii

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Information Submitted On

October 2, 1998

Submitted To:

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Executive Summary

This document prepared by the Pineapple Growes Association of Hawaii for the United States Environmental Protection Agency, provides Hawaiian pineapple grower comments on the use and benefits of fenamiphos in pineapple, suggestions on how to address pineapple-specific issues raised in the Reregistration Eligibility Document for fenamiphos, and information on actual dietary and worker exposure scenarios for potential incorporation into the final Risk Assessment for the Organophosphorous Pesticides.

The Preliminary Risk Assessment for fenamiphos indicated that chronic risks are acceptable but acute risks (dietary, worker exposure) may not be acceptable. The risk analyses in the PRA were preliminary in nature and represented the information available to EPA at the time they were prepared. In the PRA, dietary and worker exposure risks for fenamiphos uses in pineapple may be overstated for the following specific reasons discussed in greater detail in this document.

1. The actual single application and cumulative application rates are lower than allowable rates on the product label.

2. Actual preharvest intervals are significantly longer than the current 30 day preharvest interval.

3. Due to lower application rates and longer preharvest intervals, fresh and processed pineapple products do not contain detectable residues of fenamiphos, therefore, it may be appropriate to reduce the residue contribution from 0.02 ppm to 0.01 ppm.

4. Not all of the allowable use patterns are actually used by Hawaiian pineapple growers. If appropriate, the potential worker exposure scenarios in pineapple can limited closed mixing of ECs and applicator exposure for postplant drip applications or broadcast sprays.

5. Hawaiian pineapple growers have taken voluntary actions to reduce potential occupational exposure such as conversion of foliar applied acres to drip applied acres and implementation of enclosed mixing

and applications systems. Appropriate Restricted Entry Intervals for foliar applications will be recalculated based on the actual use patterns rather using maximum use patterns.

Fenamiphos is the most effective registered pesticide active ingredient for postplant control of parasitic nematodes in pineapple culture. Risks associated with fenamiphos use in pineapple are well managed and modifications can be made, if necessary, to reduce risks. The Hawaiian pineapple industry looks forward to working with EPA as the Risk Assessment is revised to ensure the continued registration of fenamiphos in agriculture.

1. Introduction

Nemacur 3 {35 percent fenamiphos: Ethyl 3-methyl-4-(methylthio) phenyl (1-methylethyl) phosphoramidate} is registered (EPA Reg. No. 3125-283) as a preplant and postplant nematicide for control of parasitic nematodes on pineapple grown in Hawaii. It is the most efficacious registered postplant nematicide and therefore is of critical importance to the Hawaiian pineapple industry.

In Hawaii, crop damage and crop failure associated with parasitic nematodes has been a continuing problem for more than 90 years. Crop damage resulting from nematode feeding can result in severe economic losses and crop failure when nematodes are not controlled. Control of parasitic nematodes in pineapple is the most important limiting factor affecting crop yields, predictability of fruit harvests, and recovery of value added fruit sizes. Without effective nematode control, the Hawaiian pineapple industry would not be competitive in today's global market ultimately leading to the closure of existing pineapple operations.

In pineapple culture, chemical control practices for nematode control includes use of preplant soil fumigants applied at time of mulching for all acreage followed by selective use of postplant applications of registered non-volatile nematicides. Fenamiphos, oxamyl, or ethoprop are used alone or in alternating applications to manage nematode population densities through inhibition of feeding and reproduction allowing for the extension of the economic crop cycle.

Use of postplant nematicides allows for the extension of the crop cycle from two (2) to three 3) crops in some pineapple growing areas. More than 85 percent of the total inputs in pineapple production are dedicated to the first two years of the crop. By extending crop cycles through effective nematode management practices, profitability of operations are improved by reduction in planting requirements and an overall reduction in pesticide (soil fumigants, herbicides) and fertilizer use.

On behalf of the Hawaiian Pineapple Industry, the Pineapple Growers Association of Hawaii respectfully submits the following written comments on industry statistics, pest biology, crop management practices, climate and hydrogeology, fenamiphos use in pineapple, importance and benefits to user, chemical and non-chemical alternatives, and risk characterization in support of the final Risk Assessment for the OPs and if appropriate, the continued registration of fenamiphos in pineapple.

1.1 Regulatory Status

Due to its high acute toxicity and widespread use on a variety of food and non-food crops, fenamiphos was one of ten organophosphorous pesticides evaluated by the Preliminary Risk Assessment (PRA) for the OPs published on August 7, 1998. The risk analyses in the PRA were preliminary in nature and represented the information available to EPA at the time they were prepared. In the case of Fenamiphos, the Reregistration Eligibility Document containing most of the available information was dated June 1994.

The Environmental Protection Agency is currently reviewing available data and will revise and refine the risk evaluations to make them more comprehensive and realistic. In the PRA, dietary and worker exposure risks for fenamiphos uses in pineapple may be overstated for specific reasons discussed in detail in the following sections.

2. Background Information

2.1 Hawaiian Pineapple Industry Statistics

Smooth Cayenne pineapple has been grown commercially in Hawaii for about 100 years. With the unfortunate decline of the sugar industry in Hawaii, the pineapple industry is currently the largest agricultural industry operating in the State in terms of employment and crop value.

Today, the pineapple industry in Hawaii cultivates approximately 27,000 acres of pineapple grown on the islands of Maui and Oahu (see Appendix A, Location Maps). Three major companies: Del Monte Fresh Produce (Hawaii) Inc, Dole Fresh Fruit Company, and Maui Pineapple Company, produce about 99.5 percent of the State's total pineapple production. Agricultural operations, cannery and fresh fruit packing facilities employs more than 3,500 people. In 1997, total pineapple production is estimated at 431 thousand tons valued at 260 million dollars.

2.2 Botanical Characteristics of Pineapple and Pest Biology

Damage to the root system and resultant yield losses are amplified by the nonregenerative botanical characteristic of pineapple roots, poor distribution of rainfall, nematodes ability to survive starvation and desiccation during fallow periods, length of crop cycles, availability of suitable habitat for reproduction and maturation, high reproductive capacity per generation, and the relatively short life cycle of reniform nematodes.

Smooth Cayenne pineapple (Ananas comosus (L.) Merr.) grown commercially in Hawaii is a perennial plant that requires functional root systems to produce multiple ratoons (or crops). Economic pineapple production in Hawaii is based on a two (2) to three (3) crop cycle requiring approximately 3 to 4 years for completion.

2.2.1 Botanical Characteristics of Pineapple

Pineapple roots originate adventitiously and do not regenerate if killed to the stem. As the stem grows, roots continue to originate in the leaf axils, however, only roots in contact with the soil are functional for absorption of soil nutrients, moisture, and anchorage of the plant. The nonregenerative botanical characteristic of pineapple roots accentuates damage caused by nematode feeding. Partial or total loss of the root system resulting from nematode feeding can result in crop failure.

2.2.2 Pest Biology

In Hawaii, of the six (6) plant parasitic nematode species found in pineapple culture, only the reniform nematode (Rotylenchulus reniformis Linford) and the root knot nematode (Meloidogyne javanica) are of major economic importance. Reniform nematodes are well adapted to pineapple field conditions and are the principal parasitic nematode species found in pineapple culture. Rootknot nematodes are not evenly distributed throughout pineapple growing areas. When present, root knot nematodes can result in severe economic losses if not controlled.

The reniform nematode is primarily an obligate, sedentary ectoparasite. Only the female is considered parasitic since males never enter and feed upon plant parts.

Juvenile females migrate into potential host roots, sometimes becoming wholly embedded, but more often their posterior ends protrudes from the roots. They feed on cortical tissue of lateral roots and do not appear to seriously affect elongation of primary roots. Females grow and develop into a saccate, kidney shape. At this stage, male fertilization occurs. Reproduction is bisexual. Cases where reniform nematodes has reproduced parthenocarpically are documented, however, such incidents are rare and the eggs produced generally do not develop.

The reniform female lays her eggs in a gelatinous matrix approximately 11 days after the start of feeding. A single female may produce 120 to 275 eggs at a time.

Eggs hatch within 8 days. At hatching, the ratio of males to females is approximately 1:1. In soil samples, males will generally outnumber females. Once they have left the egg, second stage larvae require three (3) molts to become adults. The larvae develop into males and infective females without feeding or root invasion. The complete life cycle if environmental conditions are suitable requires approximately 25 days.

During fallow periods, nematode population densities may be reduced by starvation (removal of plant hosts) and desiccation. Reniform nematodes are well adapted for survival during fallow periods. They can withstand severe desiccation surviving in an anhydrobiotic state in air dried soil for approximately 7 months.

The rate of drying is an important factor for nematode survival during desiccation. Survival is enhanced considerably when they are dried in plant tissue, mud, or similar material that reduces water loss from the nematode and/or protects it from complete dehydration.

The ability of females to enter a plant, mature, and produce eggs within 10 to 11 days increases its potential for maintaining viable, population levels.

2.3 Pineapple Crop Management

In pineapple growing areas, use of long clean fallow involving intercycle weed and pineapple volunteer control to eliminate alternate hosts helps to reduce carry over nematode infestations. Because of the limited land base, not all fields are managed under long intercycle management practices.

Two methods of land preparation used in pineapple culture are based on the length of the intercycle and potential for nematode infestation. In both systems, land preparation begins with "knockdown" or destruction of the old ratoon crop. Soil preparation for long intercycle fields includes knockdown, soil-incorporation of crop residues followed by a long clean intercycle (6 months or more) to allow for decomposition of crop residues and reduce carry-over parasitic nematode infestations. For short intercycle fields, cultivation practices include knockdown, drying and burning of crop residues prior to final land preparation. A minimum of five (5) to six (6) weeks drying time is allowed before burning of the remaining plant residues.

Following burning or a long intercycle, soil amendments (lime, phosphates) are broadcast for later incorporation into the soil. Final land preparation is accomplished with disk harrows and subsoilers used alternately to obtain the desired soil tilth. Good soil preparation in all fields is stressed to insure adequate soil continuous air space that is critical for effective preplant soil fumigation and uniform plant start.

After final land preparation, polyethylene mulch, 1,3 dichloro-propene (or methyl bromide on the island of Maui), drip tubing, and preplant fertilizers are applied from tractor mounted equipment.

Vegetative parts of the pineapple plant are planted by hand approximately 14 days after mulching operations at regular spacings marked by polyethylene mulch.

During the growing cycle, pesticides and fertilizers are applied to the crop with truck mounted sprayers and/or through the drip irrigation system to maintain healthy, productive plants. As covered in section 3, fenamiphos applications start at two to three months after planting and are used to manage nematode population levels allowing for the extension of the crop cycle.

The pineapple crop imay be irrigated with truck mounted boom irrigators, moveable sprinkler systems, or drip irrigation systems. Drip irrigation culture allows for frequent application and more efficient use of water, fertilizers, and nematicides. Drip irrigation culture has result-ed in increased yields, more uniform fruit size distribution, reduction in growing times and the capability of producing more crops per cycle. However, a large percentage of cultivated land is not or cannot be drip irrigated.

Plants are allowed to grow for 10 to 14 months until they attain plant weights of 4.0 to 6.0 pounds. When plants are vegetatively mature, flowering is induced with ethylene gas or ethephon to initiate fruit production.

The first crop, referred to as the "plant crop" is harvested 18 to 22 months after planting. Subsequent crops are referred to as "ratoon crops". Two (2) ratoon crops are normally harvested from a single planting in areas treated with postplant nematicides. The complete three (3) crop cycle from planting to last harvest requires approximately 3 to 4 years.

2.4 Climate, Geology, and Hydrology of Pineapple Growing Areas

A basic understanding of climate, geology, and hydrogeology and how these conditions may influence the degradation and movement of pesticides in the environment is critical in the development of effective crop management systems to minimize potential environmental and unintentional human health risks. Detailed stratigraphy and hydrogeology maps for Oahu and Maui are available upon request.

2.4.1 General Setting

Large scale commercial pineapple production by three separate companies is found on two of the main Hawaiian islands, Maui and Oahu. Pineapple can be grown at elevations ranging from sealevel to 3,000 feet above sealevel in a wide range of soil types and climatic conditions. Most of the commercial pineapple crop is irrigated by truck mounted overhead irrigator, moveable sprinkler, or drip irrigation systems.

On the island of Oahu, pineapple is grown in Central Oahu above four distinct aquifer systems consisting of the Pearl Harbor Aquifer, Wahiawa High Level Body, and Waialua Aquifer.

On the island of Maui, pineapple production is found in East and West Maui above three main aquifer systems: Honomanu, Kula, and Honolua.

2.4.2 The Island of Oahu

The island of Oahu was formed primarily from two shield volcanoes, Koolau and Waianae. The Koolau dome and the lower portion of the Waianae dome consist mainly of thin basaltic flows, generally less than 10 feet thick. The Wahiawa Plateau, which lies between the two volcanoes consists of lavas from the younger Koolau volcano ponded against the eroded slopes of the Waianae volcano. The permeability of the coastal plain sediments is considerably lower than the permeability of the underlying basalt aquifers. The sedimentary boundaries act as caprock restraining the seaward movement of groundwater.

The soils in pineapple field areas can be variable but consist primarily of three soil series, Kunia, Kolekole, and Wahiawa, part of the USToxic Humitropept subgroup, formerly called low humic latosols. The

Kunia and Wahiawa series are silty clays whose mineralogy is kaolintic. The soils are friable, blocky, and moderately permeable. Available moisture is approximately 15 percent. The Wahiawa series has significantly higher manganese content than the Kunia series. The soil layer may be up to two feet thick.

The depth of weathering in pineapple growing areas can be as great as 200 feet. The weathered zone consists of a few feet of soil, and then an in-situ highly weathered basalt called saprolite. The soil layer is dark red brown silty clay, the subsoil is a lighter red to tan heavier clay, and the saprolite is predominantly tan to brown and grainy. Both soil and subsoil are characteristically clayish and represent complete chemical and physical breakdown of the original basaltic rock. Saprolite retains recognizable textural features of the parent basalt while having undergone complete chemical alteration. Saprolite is among the lowest permeability rock in Hawaii. Below the weathered zone, unaltered layered basalt occurs to depths beyond the range of hydrologic interest.

Basalts are highly permeable as a result of clinker layers, lava tubes, irregular openings within and between the surface of the flows, and contraction joints that formed on solidification having hydraulic conductivities of 1000 to 2000 feet per day. In contrast, saprolite has hydraulic conductivity of less than one foot per day.

Rainfall is the ultimate source of recharge to the basal aquifers. Most of the recharge of the aquifer systems (up to 70 percent) comes from the Koolau formation. Other sources of recharge water includes subsurface inflow from dike compartments at higher elevations, seepage from streams, and deep percolation of irrigation water. Average rainfall in pineapple growing areas ranges from 28 to 60 inches per year. In general, higher rainfall is found at higher elevations and is strongly influenced by the prevailing northeast wind direction off the Koolau formation. Over pineapple growing areas, storm events are normally associated with southerly (Kona) wind direction during the winter months. Towards the south, the surface water features the two principal tributaries of Waikele Stream, Waikakalaua and Kipapa. Towards the North, surface water features include Kaukonahua and Poamoho Streams. An irrigation basin called Lake Wilson is used for recreational purposes and irrigation of sugarcane and diversified crops located to the north.

Groundwater is the principal source of drinking water on the island of Oahu. Fresh water occurs as a lens floating on salt water. Depth to groundwater varies dependent on the type of groundwater systems. Basal aquifers are found approximately 20 feet above mean sealevel. High level aquifers are found within 500 to 600 feet below ground surface. The freshwater cores are as deep as 200 feet.

Three types of regional groundwater systems have been identified in Central Oahu: the basal aquifer, dike impounded water bodies, and the Wahiawa High-Level water body. The Wahiawa High-Level Body is in the center of the island of Oahu, with dike impounded water bodies and basal water bodies on the margins of the island. In general, groundwater flows from the system of dike impounded bodies and the Wahiawa High-Level water body to the basal water bodies from high to low elevation.

2.4.3 The Island of Maui

The author of this document works primarily on the island of Oahu and is not as familiar with the climate, geology, and hydrology of Maui. Basic information on geology and hydrogeology of Maui is available upon request.

The island of Maui, like Oahu, is composed of two volcanic domes, Haleakala Volcano in East Maui and Puu Kui in West Maui. The flat isthmus connecting the two volcanoes is made up of lava from East Maui banking against the West Maui mountains.

Pineapple growing areas on Maui are not as concentrated as those found on the island of Oahu. Maui County accounts for approximately 40 percent of the State's total pineapple production. Pineapple farming operations are divided into two major areas: Honolua in West Maui and Haliimaile in East Maui. In Honolua in West Maui, pineapple production extends from sealevel to 900 feet above sealevel. In Haliimaile in East Maui, pineapple production is scattered over a wide area from 100 to 3000 feet above sealevel.

Many of the principals discussed above for Oahu applies to groundwater systems on Maui. Rainfall falling on the slopes of dormant volcanoes is the principal source of recharge. Other sources of recharge include seepage from streams and ditches and return flow from irrigated sugar and pineapple fields. Small intermittent streams flow through both Honolua and Haliimaile.

In pineapple field areas in East Maui, mean rainfall ranges from 10 (Omapio) to 50 (Haiku) inches per year. In pineapple field areas in West Maui, mean rainfall is 40 to 60 inches per year.

The soils found in pineapple growing areas on Maui are more diverse than on the island of Oahu. In the growing area centered around Haliimaile, clay, silty clay, and silty clay loam soils in the Haiku, Haliimaile, Hamakuapoko, Makawao, and Pulehu series are found. On the Honolua Plantation, silty clay, silty clay loam, and sandy loam soils in the Alae, Honolua, Lahaina, Kahana, and Molokai series are found.

The parent basalts are extremely permeable, with permeability and sustainable yield being influenced heavily by regional conditions. The Honomanu and Kula aquifers in East Maui and Wailuku aquifer in West Maui are the most productive aquifers on the island with basal water yields of 170 million gallons of water per day. In some growing areas primarily in Honolua, source of irrigation water is surface streams carried to pineapple fields by an irrigation ditch system.

3. Fenamiphos Use in Pineapple Culture

Nemacur 3 containing 35 percent fenamiphos is registered for preplant and postplant control of nematodes in pineapple culture. It is the most widely used of the three registered non-volatile nematicides for postplant applications for nematode control. Nemacur 3 is **not** applied commercially for preplant control of nematodes.

Not all of the pineapple crop in Hawaii is treated with fenamiphos. In a given year, there is a potential target of approximately 18,333 acres, however, only approximately 6,600 acres or 35 percent of the total producing acres may be treated with one or more applications of fenamiphos.

Nemacur 3 applied postplant at 0.5 to 2.0 lbs. active ingredient per acre through drip irrigation systems is a viable economic practice. Present nematode control strategies in drip irrigated areas involve reduction of carryover nematode populations with Telone II (94 percent 1,3 dichloropropene) or methyl bromide followed by postplant drip applications of fenamiphos (and other nematicides).

Not all fields are or can be drip irrigated. Foliar nematicide programs are the only alternative for postplant nematode control in overhead irrigated and unirrigated field areas. As stated in the RED, pineapple is the only crop that utilizes foliar fenamiphos applications.

Fenamiphos applications are started two to three months after planting and may be made at two to four month treatment intervals during vegetative growth and fruit development stages. The last application per crop are made 60 to 420 days before fruit harvests. The current preharvest interval is 30 days after the last application.

Typical single application rates for fenamiphos in pineapple culture range from 0.5 to 2.0 lbs. active ingredient per acre. A given field area may be treated with fenamiphos one to three times per year. Fenamiphos is used selectively based on cropping systems (ie length of fallow), historical nematode pressure, and nematode population surveys.

Of the 6,600 acres treated with fenamiphos each year, approximately 67 percent is treated through drip irrigation systems and approximately 33 percent of the total acreage is treated as broadcast spray applications.

4. Description of Importance and Benefits to User

Economic pineapple production in Hawaii is based on agricultural operations' ability to supply cannery and fresh fruit operations with controlled quantities of fruit of proper fruit size distribution during specified periods determined in planning processes three years prior to actual fruit harvests.

In current two to three crop cycle production systems, crop yield losses, shifts in fruit size distribution, delays in fruit deliveries, and infrequently crop failure by nematode damage to root systems can result in severe economic losses. In recent years, increasing foreign competition and rising production costs in Hawaii have made maximizing crop yields of marketable fruit sizes and proper scheduling of fruit deliveries increasingly more critical to economic pineapple production. Control of nematodes to minimize yield losses and disruptions in supply is critical for profitable pineapple production in Hawaii.

Use of fenamiphos and other postplant nematicides has made it technically and economically feasible to consistently produce multiple ratoon crops. In the past crop management practices based on preplant soil fumigation alone relied solely on a two crop cycle management systems to meet fruit production requirements. In recent years, increasing foreign competition and rising production costs has made it essential to reduce direct production costs by production of three crops in a crop cycle.

More than 85 percent of farm inputs in pineapple crop production occur during the first two years of the crop cycle. These inputs include land preparation, preplant soil fumigation, polyethylene mulch, drip irrigation system installation, manual planting, fertilization, and pest control programs. In subsequent ratoon crops, there are only relatively small fertilizer and pest control inputs.

In current three crop cycle management programs, direct unit production costs are reduced significantly compared to two crop cycle management programs while maintaining required production volumes. Twenty-five (25) percent less acreage can be planted each year. Pesticide, fertilizer, equipment, and energy inputs into fruit production are reduced accordingly.

Indirect benefits associated with three crop cycle management practices includes reduction in overall pesticide use, reduction in soil erosion problems, and minimization of noise, smoke, and dust nuisances associated with land preparation.

As previously stated, chemical control practices for parasitic nematode control includes use of preplant soil fumigants at time of mulching for all planted acreage followed by postplant applications of non-volatile nematicides (fenamiphos, oxamyl, or ethoprop) under certain conditions to manage nematode population densities and extend the length of the crop cycle.

Fenamiphos is the most efficacious and cost effective registered postplant nematicide for management of parasitic nematodes in pineapple culture. On the island of Oahu, average three (3) crop cycle yield increases of 18 percent have been observed in preplant 1,3 dichloropropene/postplant fenamiphos treatments compared to no postplant fenamiphos/preplant 1,3 dichloropropene controls. Postplant fenamiphos applications without preplant soil fumigation do not result in comparable yields as preplant soil fumigation only and are only slightly better than untreated controls. Without preplant or postplant nematode control, a 30 percent reduction in crop yields and a 54 percent shift to small fruit sizes can be expected when compared to preplant soil fumigation.

Reductions in yields are always associated with production of high percentages of undesirable, small fruit affecting fresh fruit and cannery recovery per acre. In present cannery and fresh fruit markets, pineapples are mechanically sorted by size and weight. There are specific customer requirements for specific sizes of fresh pineapple and for cannery packs produced from certain fruit sizes. There is little demand for fruit above or below these specific fruit size ranges. Consequently, fruit outside of desirable fruit size ranges are of lower value and are often diverted to juice concentrate operations. Juice concentrate operations are not profitable and reduce farm revenue by up to $160 per ton for fruit diverted to juice concentrate. In the three crop cycle, 1,3 dichloropropene only controls produced an average of 35 percent less fruit within desirable fruit size range (sizes 8 to 14) when compared to preplant 1,3 dichloropropene/postplant fenamiphos treatments.

Based on available field performance data, without postplant nematode control an 18 percent reduction in crop yields accompanied by a 35 percent shift in fruit size outside of marketable ranges can be expected in areas requiring postplant nematicide treatment. Without fenamiphos, current three crop cycle management systems essential to reduce production costs will be susceptible to uncontrollable shifts in fruit size distribution and yield losses, disrupting agricultural operations' ability to meet market demands severely hindering the Hawaiian pineapple industry's ability to compete with lower cost foreign producers where fenamiphos and other nematicides can be used.

5. Chemical and Non-Chemical Alternatives

Parasitic nematodes are controlled by using cultural and chemical control practices to their greatest advantage. In current large-scale production systems, chemical control is the only reliable and economically feasible alternative to ensure consistent attainment of crop yields, saleable product recovery per acre, and fruit delivery schedules.

5.1 Chemical Alternatives

5.1.1 Preplant Soil Fumigants

Telone II (EPA Reg. No. 62719), Telone C-17 (EPA Reg. No. 62719-2) Methyl bromide (EPA Reg. No. 08536-0012-43480) and Vapam (EPA Reg. No. 476-859, 1488-85) are registered for preplant soil fumigation to control parasitic nematodes in pineapple culture.

Preplant soil fumigants are used to control or knockdown carryover nematode populations. Postplant non-volatile nematicides are used to manage nematode population densities through inhibition of feeding and reproduction and slowing or delaying logarithmic population increases that result in severe crop damage and significant economic losses.

Telone II is the most widely used preplant soil fumigant used in pineapple culture in Hawaii. Telone C-17 is not routinely used due to the lack of bulk transport tanks and storage facilities approved for the handling of the product. Methyl bromide is a potential ozone depleting chemical that is being phased out of use by the Montreal Protocol by the year 2005. Due to differences in pest problems, methyl bromide is used on the island of Maui only. Vapam is not routinely used as a preplant application by pineapple growers due to higher costs, lower efficacy caused by poor soil movement, and potential phytotoxic effects.

Since preplant soil fumigants and postplant nematicides serve two distinctly different purposes, preplant soil fumigants alone cannot be considered as viable economic alternatives for nematode control in pineapple in Hawaii.

5.1.2 Vydate L

Vydate L {oxamyl: Methyl N[1] N[1] - dimethyl - N - L (methyl-carbamoyl) oxy] - 1 - thio - oxamimidate} is registered (EPA Reg. No. 352-372) for preplant and postplant broadcast spray and drip applications for control of reniform and root knot nematodes in pineapple.

Research completed by the Pineapple Research Institute indicated the oxamyl (10% Granular) does not give adequate nematode control at acceptable rates (40 lbs. active ingredient per acre) and is not a cost effective preplant treatment. Registered emulsifiable concentrate formulations (Vydate L) are **not** applied commercially for preplant control of nematodes.

Oxamyl may be applied postplant through the drip irrigation system or as foliar sprays to about 35 percent of the active growing areas, but is not as widely used as fenamiphos. Where used, oxamyl, a carbamate pesticide is used in rotation with fenamiphos to miminize risks of development of nematode resistance and accelerated microbial degradation in the field. Nematode control strategies in drip irrigated areas are similar to practices discussed for fenamiphos.

In drip irrigated areas, significantly yield increases have been detected in preplant 1, 3 dichloropropene / postplant oxamyl treatments when compared to preplant 1, 3 dichloropropene treatments. Postplant oxamyl without preplant 1, 3 dichloropropene soil fumigation is only slightly better than (non-fumigated / no postplant nematicide) untreated controls.

Oxamyl may be commercially applied as foliar broadcast sprays in overhead irrigated and unirrigated pineapple fields. Positive yield responses from foliar applications are not as predictable as drip applications.

Oxamyl is an effective pest management tool to control nematodes and increase yields in areas treated with 1, 3 dichloropropene when used in rotation with fenamiphos. However, oxamyl alone is not a technically feasible alternative for fenamiphos for postplant nematode control programs. As a carbamate, oxamyl may be subject to many of the same conditions for continued registration as fenamiphos.

5.1.3 Mocap EC

Mocap 6EC (ethoprop: O - Ethyl S, S Dipropyl Phosphorodithioate) is registered (EPA Reg. No. 359-696) for postplant drip applications to control nematodes in pineapple.

Postplant ethoprop applications has not been routinely used commercially. Field studies indicate that at higher rates, ethoprop may be a suitable alternative for incorporation into intergrated postplant nematode control programs.

Ethoprop alone is not a technically feasible alternative for fenamiphos for postplant nematode control.

5.2 Non-Chemical Alternatives

Non-chemical means of managing parasitic nematodes in pineapple are not well developed. Recent regulatory actions and increased sensitivity to pesticide use has shifted resources to development of new cultural practices, biological controls, and varietal development as management tools to reduce and/or eliminate pesticide use.

At this stage of development, non-chemical nematode control alternatives must be considered experimental and (with the exception of use of fallow periods and crop rotation) have never been tested on a large scale basis.

5.2.1 Long Fallow

Long, clean fallow periods to reduce carryover nematode infestations by taking advantage of starvation and dessication of nematodes during crop intercycles is a common practice in the Hawaiian pineapple industry.

Normal fallow periods are six (6) months to one year. However, due to the limited land base and high land lease costs, not all fields can be managed using longer fallow periods and still maintain current production levels.

Long fallow periods in itself are not effective in reducing reniform nematode population densities below economically damaging levels. Reniform nematodes have the ability to infest alternate plant hosts (ie weeds) and volunteer pineapple during the intercycle. Even after four years of "clean" fallow, nematodes persist in soil and without the use of soil fumigation and postplant nematicides can quickly multiply to damaging levels.

With incorporation of residual plant material, long fallow periods are very effective in helping to improve soil tilth after final land preparation and can contribute to increased crop yields with effective nematode control.

5.2.2 Crop Rotation

There are very few crops that may be economically rotated with a high value, long-term crop like pineapple. Due to the poor rainfall distribution, crop rotation in most pineapple growing areas is not economically feasible due to the high cost of planting and irrigation. Other factors affecting the use of cover crops include potential for phytotoxic effects from residual herbicides, plant-back restrictions on pesticide labels, the need to maintain the cover crop for a prolonged period of time (6 to 12 months), and the potential for the cover crop to become a weed in the subsequent pineapple crop cycle.

To develop economically viable cover crop programs, pineapple growers in cooperation with the University of Hawaii are evaluating cover crops in high rainfall areas to assess their potential for reducing nematicide and herbicide use. These studies are on-going and must be considered as preliminary in nature.

5.2.3 Biological Control

Greenhouse studies evaluating various biological control agents (Pasteuria penetrans, Paecilomyces lilacinus, Phialophora malorum) completed by the University of Hawaii indicated that biological control agents do not provide consistent, effective control of reniform nematodes.

DiTera, a dried fermentation product of Myrothecium verrucaria, is being evaluated by the University of Hawaii for preplant and postplant nematode control. However, even if moderately effective, the high application rates (5 to 40 gallons) of the fungal product per acre may make it economically unfeasible to use in pineapple.

The research data base is too limited to properly assess if biological control agents can provide an effective preplant or postplant means of controlling nematodes in pineapple.

5.2.4 Varietal Development and Genetic Engineering

The Pineapple Research Institue evaluated literally hundreds of thousands of different pineapple selections produced by cross pollination for a 50 year period, but was unable to develop a nematode resistant or nematode tolerant pineapple variety of commercial utility.

In 1995, a working group consisting of researchers from the USDA-ARS, University of Hawaii, and Hawaii Agricultural Research Center started using genetic engineering methods to develop nematode resistant pineapple varieties using proteinase inhibitor technology. Genetic transformation are underway with a target for field testing by the year 2002.

If transformed plants evaluated in the field performance trials by the year 2002 prove to be resistant or tolerant to damage from nematode feeding, it will take an additional 7 to 10 years to convert entire plantations to the new transformed varieties. The Hawaiian pineapple industry is optimistic that through the use of the best available technology, the Project will be sucessful and provide a viable, non-chemical alternative in the future.

6. Risk Characterization in Pineapple

The Environmental Protection Agency has more information and resources than grower groups for evaluating human health and environmental risks that may be associated with agricultural use of pesticides.

Therefore, to meet the objectives of this document only a brief summary of the site-specific and chemical case specific issues relating to acute dietary risks, worker exposure, and environmental fate of fenamiphos are presented.

6.1 Acute Dietary Risks

The tolerance in 40 CFR 140.349 for fenamiphos residues in or on pineapple is 0.3 parts per million. The feed additive tolerance in 40 CFR 140.2950 for fenamiphos in or on pineapple bran is 10.0 ppm.

The quantitative nature of residues in pineapple and other commodities were established in field crop residue studies using maximum application rates at the maximum application frequency. In field and laboratory studies, fenamiphos is readily absorbed from soils, foliage, and fruits, and translocated throughout the plant. Plant metabolism involves the oxidation of fenamiphos to fenamiphos sulfoxide and or fenamiphos sulfone, subsequent hydrolysis to fenamiphos sulfoxide phenol and fenamiphos sulfone phenol, and the formation of the glucoside or other conjugates. The terminal residues of concern are fenamiphos, fenamiphos sulfoxide, and fenamiphos sulfone.

Potential dietary risks from fenamiphos use in pineapple are minimized through use of lower than allowable single and cumulative application rates, application at infrequent intervals, use of chemigation application methods, and voluntary enforcement of longer than required preharvest intervals.

Qualitative field crop residue studies by Del Monte (see Appendix B) evaluating residues in the edible pulp and on the fruit shells resulting from typical commercial use patterns for fenamiphos indicated:

* In the Del Monte field 2034 located in Kunia, Oahu, Hawaii, Smooth Cayenne pineapple were treated with thirteen (13) drip applications of fenamiphos at 0.5 lb. active ingredient per acre or a total of 6.5 lbs. active ingredient in the plant crop. Fruit samples collected at 112 days after the last application did not contain detectable residues of fenamiphos at a detection limit of 0.01 ppm.

* In the Del Monte field 2005 located in Kunia, Oahu, Hawaii, Smooth Cayenne pineapple were treated with ten (10) foliar applications of fenamiphos at 2.0 lbs. active ingredient per or a total of 20.0 lbs. active ingredient per acre in the plant crop. Fruit samples collected at 138 days after the last application did not contain detectable residues of fenamiphos at a detection limit of 0.01 ppm.

* Untreated controls collected from field 2034 did not contain detectable residues of fenamiphos at a detection limit of 0.01 ppm.

Additional Market Basket Residue Survey information from Del Monte and Maui Pineapple Company for fresh whole pineapple, canned pineapple, and pineapple by-products is provided in Appendix C. Fresh fruit and canned pineapple samples were collected in destination markets and analyzed using standard FDA analytical methods. The results of the laboratory analyses indicated that no detectable residues of fenamiphos were found in or on fresh whole pineapple, in canned pineapple products, and in pineapple by-products used for animal feed.

The RED for fenamiphos required the establishment of a food additive tolerance for pineapple juice. However, this requirement may not be appropriate or necessary since residues are not found on the raw product and concentration of residues in pineapple juice does not appear to be a significant factor in the assessment of dietary risks. The pineapple industry would like to work with EPA and the Bayer Corporation to determine how this requirement can be addressed without the conduct of additional field crop residue and processing studies.

In order to decrease potential dietary risks, it may be appropriate to increase the preharvest interval for fenamiphos from 30 to 60 (or more days). If acceptable to EPA, Hawaiian pineapple growers would like to suggest increasing of the preharvest interval to reduce the need for further residue studies to establish a tolerance for pineapple juice.

Pineapple foliage or green crop is **not** used for animal feed. Pineapple processing wastes consisting of wet skins, end cuts, cores, and waste pulp may be fed to animals. State of Hawaii feed quality surveys indicate that fenamiphos residues has never been detected in pineapple processing wastes. Therefore, potential dietary risks associated with the pineapple use pattern from the consumption of meat, poultry, and milk is not significant.

In general, pineapple is not rotated with any other crops, therefore, dietary risks that may be associated with rotational crops is not a factor for pineapple production.

Due to the low daily consumption rate, non-detectable anticipated residues, and the use of 36 percent of the crop treated in risk calculations, acute dietary risks for pineapple are acceptable and should not contribute significantly to cumulative dietary risk assessment.

6.2 Worker Exposure

6.2.1 Mixer/Loader/Applicator Exposure

In the RED, exposure values for fenamiphos uses in pineapple were calculated using two major exposure scenarios: 1) Mixer/Loader Exposure Levels for open mixing of emulsifiable concentrates for foliar sprays and chemigation, and 2) Applicator Exposure Levels for Broadcast Sprays (and Granular applications) applied preplant, postharvest (ratoon), postplant (pre-emergent). Due to unavailability of drip irrigation systems in certain field areas, pineapple is the only crop that uses foliar broadcast spray applications of fenamiphos for nematode control. The Maximum Observed Effect Level for the exposure scenarios in the RED is summarized in Table 6-1.

Table 6-1. Summary of Exposure Values for Fenamiphos-Pineapple

Mixer/Loader Exposure Levels.	Maxiumum Rate.	MOE(dermal)
Open Mixing Granulars	10.0 lb. ai/acre	5.0
Open Mixing ECs	20 lb. ai/acre	0.1
Open Mixing ECs for Chemigation	9.0 lb. ai/acre	0.1

Applicator Exposure Levels.

Preplant Broadcast Spray	20.0 lb. ai/acre	1.9
Postharvest (Ratoon) Spray	10.0 lbs. ai/acre	3.8
Postplant, Pre-emergent Spray	3.0 lbs. ai/acre	12.5
Preplant Broadcast Granular	20.0 lbs. ai/acre	< 0.1

Potential agricultural worker exposure risks associated with fenamiphos use in pineapple are well managed. Preplant applications are not used in commercial pineapple production in Hawaii and granulars are not registered for use in Hawaii.

Based on the allowable use patterns in pineapple, three worker exposure scenarios should be considered in the assessment of acute exposure risks. The agricultural worker categories who may be potentially exposed during the mixing, handling, or application of fenamiphos are described below.

Supply Truck Driver. The Supply Truck Driver measures, mixes, and transports fenamiphos solutions for foliar applications to field application sites. The typical application rate for foliar applications is 2.0 lbs. active ingredient per acre in 250 gallons of water. The mixing tank size may vary, but averages 3200 gallons. One supply truck tank will provide the required spray volume for 12.8 acres. In an 8-hour shift, a Supply Truck Driver may mix a maximum of 8 tank loads. The typical mixing and field transport scenario includes filling of the supply truck tank to 1/2 full with water then measuring/pouring fenamiphos into the tank and finally filling of the tank with the remaining 1/2 tank volume of water followed by closed agitation prior to transfering into the spray tank.

Spray Truck Operator. The Spray Truck Operator applies the diluted fenamiphos solutions as foliar broadcast spray. The Spray Truck Operator drives and operators truck mounted boom sprayers from an enclosed cab. At a water carrier rate of 250 gallons per acre, approximately 100 acres may be treated in one 8 hour shift per day.

Drip Irrigation System Operator. Drip irrigation system operators transport fenamiphos in the orginal containers to drip irrigation stations. The application rates in drip irrigated fields range from 0.5 to 2.0 lbs. active ingredient per acre. The majority of the treated acreage is treated with the lower application rates. The typical target area for fenamiphos applications in drip irrigated fields is 20 acres per irrigation set. In an 8 hour shift, two drip irrigation sets or approximately 40 acres may be treated.

The parameters used to calculate worker exposure risks in the RED do not accurately reflect the current and future worker exposure scenarios. The Hawaiian pineapple growers are currently purchasing enclosed measuring and application systems for chemigation and foliar applications, therefore, future exposure will not include open mixing of emusifiable concentrates. Granulars are not registered for use in pineapple, therefore, open mixing of granulars will not contribute to potential worker risks. Preplant applications of ECs are not used, therefore, if risks are unacceptable this use pattern may be eliminated after consultation with the Bayer Corporation.

The exposure scenarios for pineapple that should be retained in the revised risk calculations consists of:

Mixer/Loader Exposure

* Broadcast Spray, Postplant, post-emergent at 2.0 lbs. a. i./acre and Daily Maximum Treated of 100 acres.

Applicator Exposure

* Broadcast Spray, Postplant, post-emergent at2.0 lbs. a.i./acre and Daily Maximum Treated of 100 acres.

* Closed Mixing for Chemigation, post-emergent at 2.0 lbs. a.i./acre and Daily Maximum Treated of 80 acres.

The use of personal protective equipment provides for adequate protection of agricultural workers who may be occupationally exposed to fenamiphos. Medical Surveillance Programs at Del Monte clearly demonstrates that mixer/loaders/applicators of OPs and other pesticides are well protected (see Appendix D). The Medical Surveillance Program at Maui Pineapple suggests that similiar conditions exist for pineapple workers on Maui. Due to lesser use of OPs, Dole Fresh Fruit Company does not maintain a Medical Surveillance Program.

Hawaiian pineapple growers constantly strive to improve on worker safety procedures. Although current exposure scenarios appear to be acceptable, the implementation of closed mixing systems will further reduce potential exposure in the work environment.

6.2.2 Post Application/Re-Entry Exposure

As previously stated, fenamiphos is most commonly applied to the soil using drip irrigation systems located under agricultural mulch. In the absence of drip irrigation systems, fenamiphos may be applied as foliar broadcast sprays.

The current Restricted Entry Interval for drip and foliar applications in pineapple is 48 hours. In the RED, the registrant proposed to establish a restricted entry interval for foliar applications of 17 days for pineapple. Since there is no significant with drip applications, the REI will remain at 48 hours.

The proposed 17 day REI was based on the study entitled, "Foliar Residue Following Application of Nemacur to Pineapples (MRID No. 419017-01) submitted by Mobay Corporation (currently the Bayer Corporation). The study was conducted at 3 sites in Hawaii (two Del Monte sites and one Dole site) using an application rate of 10 lbs. active ingredient per acre. The current application rate for foliar applications is 2 lbs. active ingredient per acre, 5 times lower than the rate used in the dislodgeable residue study.

The dislogeable residue study may overstate potential post-application exposure for foliar applications on pineapple. The Hawaiian pineapple industry has requested that the Bayer Corporation recalculate the acceptable exposure levels based on the actual application rate. If acceptable, a 5 to 7 day REI would be more manageable while being protective of human health.

6.3 Environmental Fate

The water solubility of fenamiphos is 700 mg/l. Fenamiphos has K_{OC} values of 148 to 249 and can be classified as a medium mobile (McCall etal 1980). Its degradation products, fenamiphos sulfone and fenamiphos sulfoxide can be classified as high mobiles. The mobility of fenamiphos is inversely proportional with the organic matter content and the cation exchange capacity of the soil.

In environmental fate studies, Fenamiphos sulfoxide is the most persistent followed by fenamiphos sulfone and fenamiphos. Site-specific studies on the degradation and movement of fenamiphos in Hawaiian soils are available upon request. More information on sorption and leaching of aldicarb, oxamyl, and fenamiphos can be found in Bilkert, J.N. and Rao, P.S.C., Sorption and Leaching of Three Nonfumigant Nematicides in Soil, Journal of Science Health B20(1) 1-26, 1985.

6.3.1 Case Studies

In response to Del Monte Fresh Produce (Hawaii) Inc.'s information request, the Bayer Corporation provided some information on the area in Highlands County, Florida where groundwater contamination by agricultural use of fenamiphos was detected.

In Florida, the depth to groundwater in the study area was 11 to 34 feet. The soil type was Astatula sand containing 79 to 100 percent sand, 0 to 10 percent silt, and 0 to 21 percent clay, and 0 to 1.3 percent organic matter. The permeability of the soil was greater than 20 inches per hour.

In Hawaii on the island of Oahu, the depth to groundwater below pineapple growing areas ranges from 500 to 1,180 feet. The soil types are variable but in general contain 70 to 80 percent clay, 20 to 30 percent silt, and 1 to 4 percent organic matter. The permeability of the underlying subsoil and weathered rock is less than 0.5 inch per hour. Although fenamiphos use patterns, hydrogeologic conditions, and soil types are not highly conducive to groundwater contamination, pineapple growers are willing to make any reasonable changes to product labels, if determined to be appropriate and necessary, to minimize potential environmental risks.

Groundwater quality monitoring programs conducted under the Safe Drinking Water Act in agricultural areas on the islands of Maui and Oahu have never detected fenamiphos or other OPs in groundwater.

7. Concluding Remarks

Fenamiphos is one of the most effective pesticide active ingredients for control of plant parasitic nematodes injurious to a wide variety of food and non-food crops. Because of its widespread utility, fenamiphos has been the focus of extensive research efforts to evaluate its effects in agriculture, on living systems, and the environment.

In the case of pineapple, it is the most effective registered pesticide active ingredient for postplant control of parasitic nematodes in pineapple culture. Other registered postplant alternatives, ethoprop and oxamyl, are more costly and are not as effective as fenamiphos. Conversion from fenamiphos to other alternatives may not reduce but instead increase potential dietary, worker exposure, and environmental risks associated with agricultural use of pesticides. Loss of registered postplant nematicides will make it impossible to remain as viable, economic businesses in Hawaii.

Dietary and worker exposure risks that may be associated with commercial use of fenamiphos in pineapple should be recalculated using the following assumptions:

Dietary and Worker Exposure Risks

* Not all of the pineapple crop grown in Hawaii is treated with Fenamiphos with an average of 35 percent of the crop treated each year. The Average Daily Intake or consumption of pineapple treated with fenamiphos can be retained at 36 percent of the crop.

* The preliminary dietary risk assessment assigned a residue contribution in pineapple of 0.02 parts per million. Limited Market Basket and field crop residue data indicates that fresh and processed pineapple products do not contain any fenamiphos

residues at a detection limit of 0.01 ppm. If acceptable to EPA, the residue contribution for pineapple can be reduced to 0.005 ppm. The reduction in the ADI and residue contribution will significantly reduce calculated acute dietary risks for pineapple.

* Dependent on the growing area, the actual preharvest intervals range from 60 to 420 days. The preharvest interval can be administratively changed from 30 days to 60 days. The change will more accurately reflect current and future use patterns and provide additional assurances in meeting low residue contribution assumptions in the final Risk Assessment.

* The 20 lb. active ingredient per acre preplant application rate is **not** and **will not** be used in Hawaii. However, the preplant application use pattern should continue to be evaluated to determine if risks are acceptable. If the risks are unacceptable, EPA and Bayer Corporation may take appropriate actions to reduce risks.

* Medical Surveillance Programs demonstrate that mixers/loaders/ applicators are well protected are continuing. In addition, acute worker exposure risks will be reduced using the following integrated approach. Foliar applications will be limited to essential acres only. For drip and foliar applications, the Hawaiian pineapple industry will use standardized enclosed measuring and application systems to further reduce potential human health risks.

* Pineapple foliage or green chop is not sold or used for animal feed. Pineapple processing wastes may be fed to animals. Since there are no detectable residues on the raw product or pineapple by-products, residues in meat or milk is not a factor in the risk assessment for fenamiphos use in pineapple.

* The dislodgeable residue study recommended establishment of a 17 day Restricted Entry Interval for foliar applications of fenamiphos. Significantly lower rates are actually used than the 20 lb. active ingredient rate per acre evaluated in the dislodgeable residue study. The relatively low frequency (maximum of two to four months treatment intervals) foliar applications allows for the degradation processes to occur reducing risks further. The preliminary

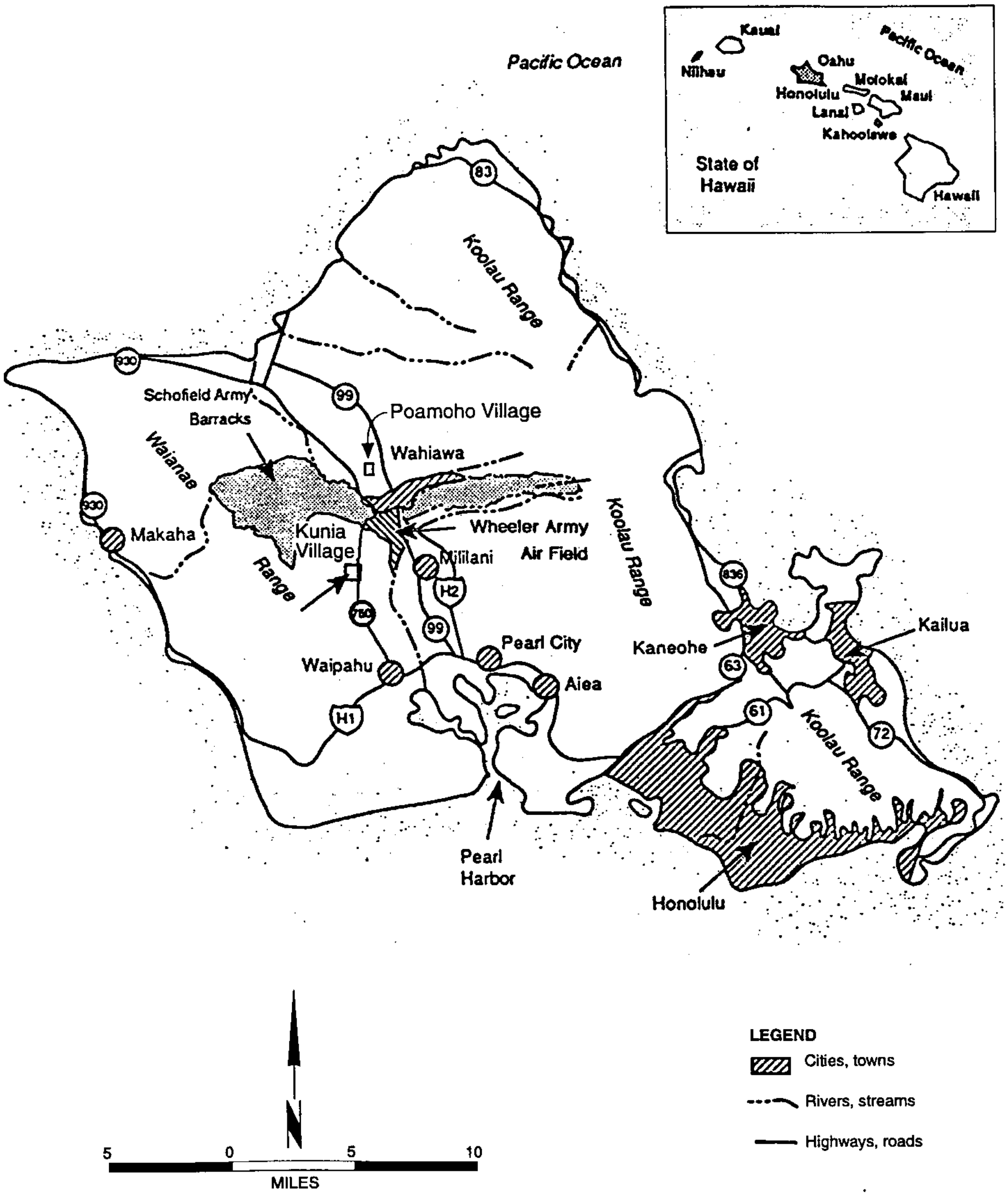
evaluation indicates that the REI can conservatively be reduced to 5 days. The Bayer Corportion will recalculate acceptable risks based on actual use patterns to determine if the proposed REI can be reduced.

* Current cumulative application rates on product labels are excessive and can be reduced. If determined to be necessary, voluntary label amendments reducing cumulative rates for plant crops from 13 1/3 gallons to not more than 8 1/2 gallons per acre and for ratoon crops from 6 2/3 gallons to not more than 4 gallons per acre.

User impacts from the loss of fenamiphos registrations in pineapple would be devastating and seriously jeopardize our ability to remain as economically viable businesses in Hawaii. Loss of fenamiphos registrations will trigger increased use (higher rates and more frequent use) of soil fumigants and more widespread use of oxamyl and ethoprop in pineapple. With the shifts in pesticide use, associated risks will increase accordingly.

The Hawaiian pineapple industry fully supports the Environmental Protection Agency's goals to assure safety of fenamiphos use in agriculture and greatly appreciates the opportunity to participate in the regulatory process by providing the comments contained in this document. Hopefully, the Environmental Protection Agency reaches the conclusion that human health and environmental risks are acceptable thus allowing for the continued registration of fenamiphos in pineapple with minimal label modifications .

APPENDIX A



Pacific Ocean
Kauai
Niihau
Oahu
Pacific Ocean
Molokai
Honolulu
Maui
Lanai
Kahoolawe
State of Hawaii
Hawaii
83
Koolau Range
930
Schofield Army Barracks
99
Poamoho Village
Wahiawa
Waianae Range
Makaha
Kunia Village
Wheeler Army Air Field
Mililani
Koolau Range
H2
836
780
99
Pearl City
Kaneohe
Kailua
63
Waipahu
Aiea
H1
61
Koolau Range
72
Pearl Harbor
Honolulu
LEGEND
Cities, towns
Rivers, streams
Highways, roads
5
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5
10
MILES
N

APPENDIX B

Del Monte

Del Monte Corporation • Hawaiian Operations, P.O. Box 200, Kunia, HI 96759

August 13, 1984

Mr. Charles Yasuda
State Of Hawaii
Department Of Agriculture
Pesticide Branch
1428 So. King Street
Honolulu, Hawaii 96814

Dear Charley:

Recently, Del Monte was advised by EPA that wet skins of pineapple are "fodder." The restrictive statement, "Do not feed forage or fodder to animals," on the Nemacur label prohibits Del Monte and other pineapple companies from selling wet skins from processing fruit treated with Nemacur for animal feed. Presently, the wet skins are discarded at substantial hauling costs, a cost that will increase in the future.

Mobay Chemical Corporation plans to remove the restrictive statement in their next label application and allow feeding of fodder (wet skins) to animals.

In the interim, Del Monte Corporation management has requested written approval from the Hawaii State Department of Agriculture to allow feeding of wet skins to animals (letter to Dr. Lyle Wong from C. Oda dated 8/3/84). To support the request, residue information was developed to establish that Nemacur residues in or on wet skins treated with present commercial practices are within acceptable tolerances (21CFR 561.232) for residue in or on pineapple bran (10 ppm).

Samples of pineapple fruit from areas treated with foliar or drip applications of Nemacur were analyzed for Nemacur residue. Residue levels in or on flesh and wet skins along with the treatment history are being reported to you under separate cover.

If you have any questions or require additional information, please contact me.

Sincerely,

DEL MONTE CORPORATION

Calvin H. Oda

Calvin H. Oda

Attach.
CHO/ysi

xc: FEDillard, Jr.
RDCarter
RJFoster
JLWrixon
File

8/28/84
[illegible] hand carried by Oda w/o attach.

NEMACUR RESIDUE ANALYSES (3 Fruit Samples)

1. Kunia, Hawaii Field 2034 Block 22 - Shipped by C. Oda - Wayne Thornburg 6/6/84, received 6/8/84.

   Treated: 1/12/83, 2/9, 3/9, 4/6, 5/4, 6/15, 7/12, 8/10, 9/14, 10/5, 11/2, 12/14 and 1/10/84.

   Sampled: 5/1/84 (112 days after last application).

Sample No.	Nemacur Treatment (Drip)	Residue (ppm) Flesh	Wet Skins
1	0.5 lb. active ingredient per acre/	<0.01	<0.01
2	application (to a total of 6.5 lbs.	<0.01	<0.01
3	a.i. for plant crop).	<0.01	<0.01

2. Kunia, Hawaii Field 2005 Block 15 - Shipped by C. Oda - Wayne Thornburg 6/6/84, received 6/8/84.

   Treated: 3/31/83, 4/28, 5/24, 6/30, 7/28, 8/31, 9/30, 10/28, 12/1 and 1/4/84.

   Sampled: 5/21/84 (138 days after last application).

Sample No.	Nemacur Treatment (Foliar)	Residue (ppm) Flesh	Wet Skins
1	2.0 lbs. active ingredient per acre/	<0.01	<0.01
2	application (to a total of 20.0 lbs.	<0.01	<0.01
3	a.i. for plant crop).	<0.01	<0.01

3. Kunia, Hawaii Field 2034 Block 21 - Shipped by C. Oda - Wayne Thornburg 6/6/84, received 6/8/84.

   Treated: No Nemacur treatment.

   Sampled: 5/1/84

Sample No.	Nemacur Treatment	Residue (ppm) Flesh	Wet Skins
1	None.	<0.01	<0.01
2		<0.01	<0.01
3		<0.01	<0.01

Del Monte

Del Monte Corporation • Hawaiian Operations, P.O. Box 200, Kunia, HI 96759

August 3, 1984

Dr. Lyle Wong
Chief, Pesticides Branch
State Department Of Agriculture
P. O. Box 22159
Honolulu, Hawaii 96822

Dear Lyle:

Recently, Del Monte was advised by EPA that wet skins of pineapple are "fodder." The restrictive statement, "Do not feed forage or fodder to animals," on the Nemacur (EPA Reg. No. 3125-284) label prohibits Del Monte and other pineapple companies from selling for animal feed wet skins from processing fruit treated with Nemacur. Presently, wet skins from Nemacur treated fruit are discarded at substantial hauling costs, a cost that will increase once juice concentration operations commence in September 1984.

Mobay Chemical Corporation plans to remove the restrictive statement in their next label application and allow feeding of fodder (wet skins) to animals. In the interim, the additional hauling costs would result in substantial economic losses and would limit the use of Nemacur, one of only two postplant nematicides available to the industry, during a difficult transition period following the loss of ethylene dibromide for soil fumigation.

Tolerances in 21 CFR 561.232 for residues of Nemacur in or on pineapple bran is 10.0 ppm. Tolerances have also been established (40 FR 180.349) for Nemacur residues in or on the commodities meat, fat, and meat by-products of cattle, goats, hogs, horses and sheep at 0.05 ppm and whole milk at 0.01 ppm.

Results of residue analysis (Attachment 1) for drip and foliar Nemacur applications establishes that residues in or on wet skins are well below the tolerance set for bran. Del Monte Corporation management believes that this matter is eligible for a determination by the State Department Of Agriculture acting for EPA under Section 2 (ee) of the FIFRA. If it is judged that feeding of wet skins to animals is not inconsistent with the intent of the label, Del Monte would like the State Department Of Agriculture's approval to make available for sale wet skins for animal feed.

If you have any further questions or require additional information, please call me at 621-1205.

Sincerely,

DEL MONTE CORPORATION

Calvin H. Oda

Calvin H. Oda
Research Manager

Attach.
CHO/vsi

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8/~~29~~/84

ATTACHMENT 1

Treatments	ppm Nemacur	
	Flesh	Wet Skins
1. Preplant Telone and 24 lbs. active ingredient (cumulative) applied as postplant foliar sprays.	< 0.01	< 0.01
	< 0.01	< 0.01
	< 0.01	< 0.01
2. Preplant Telone and 6.0 lbs. active ingredient (cumulative) applied postplant via the drip irrigation system.	< 0.01	< 0.01
	< 0.01	< 0.01
	< 0.01	< 0.01
3. Preplant Telone only.	< 0.01	< 0.01
	< 0.01	< 0.01
	< 0.01	< 0.01

APPENDIX C

The National Food Laboratory, Inc.
6363 CLARK AVENUE, DUBLIN, CALIFORNIA 94568-3097
(510) 828-1440 • Fax (510) 833-8795

January 20, 1998

Analytical Report No: CL 3558

Mr. William Mahin
Maui Pineapple Company, Ltd.
120 Kane Street
Kahului, HI 96732

Dear Mr. Mahin:

Listed below are the multiresidue results on sample(s) received on January 7, 1998.

NFL ID	AA51462	AA51463	AA51464	AA51465
Client code	Pineapple Juice	Pineapple Concentrate	Pineapple Syrup	Passion Fruit Conc.
Organochlorinated	ND(0.05)	ND(0.20)	ND(0.20)	ND(0.20)
Organonitrogens	ND(0.02)	ND(0.10)	ND(0.10)	ND(0.10)
Organophosphates	ND(0.01)	ND(0.05)	ND(0.05)	ND(0.05)
N-methyl Carbamates	ND(0.05)	ND(0.10)	ND(0.10)	ND(0.10)

ND: None detected. All units are in mg/kg(ppm). Detection limits are in ().

Please note that these results apply only to the sample(s) submitted for this report. Samples from a different portion of the same lot may produce different results.

Your sample(s) will be held for thirty days from the date of this report. If we do not hear from you by that time, your sample(s) will be discarded.

Please do not hesitate to call us if you have any questions or concerns regarding this report.

Thank you for using the services of The National Food Laboratory.

Sincerely;

Lori D'Albora

Lori D'Albora
Project Leader

cc: Mary Jo Smith, NFL Accounting

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Approved: Julia Hill
Julia Hill, Div. Manager, Chemistry

Date: 1/22/98

The National Food Laboratory, Inc.
6363 CLARK AVENUE, DUBLIN, CALIFORNIA 94568-3097
(925) 828-1440 • Fax (925) 833-8795

July 20, 1998

Mr. William Mahin
Maui Pineapple Company, Ltd.
120 Kane Street
Kahului, HI 96732

Analytical Report No: CL 3912
Purchase Order No: K-120062

SKINS INCLUDED IN PULP SAMPLE

Dear Mr. Mahin:

Honolua Yamamura (Private grower)

Listed below are the results of our analysis on sample(s) received on July 9, 1998.

NFL ID	AA58406	AA58407	AA58408	AA58409	AA58410
Sample Description	H'Maile Pineapple Pulp	~~Honolulu~~ Pineapple Pulp	~~Yamamwa Pineapple~~ Pulp	Papaya Pulp	Canned Pineapple Slices in Juice
Analyte	***Results***				
Organochlorinated	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
Organonitrogen	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)
Organophosphate	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
N-methyl Carbamates	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)

ND: None detected. All units are in mg/kg(ppm). Detection limits are in ( ).

Please note that these results apply only to the sample(s) submitted for this report. Samples from a different portion of the same lot may produce different results.

Your sample(s) will be held for thirty days from the date of this report. If we do not hear from you by that time, your sample(s) will be discarded.

Please do not hesitate to call us if you have any questions or concerns regarding this report.

Thank you for using the services of The National Food Laboratory.

Sincerely;

Grace Q. Bandong
Project Manager, Chemistry

cc: Mary Jo Smith, NFL Accounting

gqb/ao.xls

FS-26
3/86

State of Hawaii
DEPARTMENT OF AGRICULTURE
Commodities Branch

FEED ANALYSIS REPORT

Adulteration

1. DATE SAMPLED	November 28, 1995
2. SAMPLE NO.	35257A
3. HAWAII REGISTRATION NO.	Exempt
4. LOT SIZE: Bags	Tons
Bulk Tons	4.0
5. BRAND OR PRODUCT NAME	Pineapple wet skins
6. PRODUCTION CODE	

7. NAME AND ADDRESS OF MANUFACTURER (Include Zip Code)

Del Monte Fresh Produce Hawaii
P.O. Box 200
Kunia, HI 96759

8. NAME AND ADDRESS OF FEED DEALER OR CONSIGNEE (Include Zip Code)

Sampled at: 94-1000 Kunia Road
Kunia, HI 96759

9. RESULTS OF ANALYSIS

Organochlorine Pesticides (1)

Pesticide (Detection Limit *)	Found
Aldrin (0.01 ppm)	ND
Bayleton (0.01 ppm)	ND
Captan (0.02 ppm)	ND
Cis-chlordane (0.02 ppm)	ND
op-DDD (0.04 ppm)	ND
pp-DDD (0.04 ppm)	ND
op-DDE (0.02 ppm)	ND
pp-DDE (0.01 ppm)	ND
op-DDT (0.04 ppm)	ND
pp-DDT (0.04 ppm)	ND
Dicofol (0.02 ppm)	ND
[illegible]in (0.02 ppm)	ND
Endrin (0.04 ppm)	ND
Endosulfan I (0.02 ppm)	ND
Endosulfan II (0.02 ppm)	ND
Endosulfan Sulfate (0.02 ppm)	ND
Heptachlor (0.005 ppm)	ND
Heptachlor Epoxide (0.02 ppm)	ND
Lindane (0.005 ppm)	ND
Methoxychlor (0.02 ppm)	ND
Mirex (0.02 ppm)	ND

Organophosphorous Pesticides (1)

Pesticide (Detection Limit *)	Found
Carbophenothion (0.02 ppm)	ND
Chlorpyrifos (0.02 ppm)	ND
Cygon (0.02 ppm)	ND
DEF (0.02 ppm)	ND
Diazinon (0.01 ppm)	ND
Ethion (0.02 ppm)	ND
Fonofos (0.02 ppm)	ND
Ethoprop (0.02 ppm)	ND
Gardona (0.01 ppm)	ND
Malathion (0.01 ppm)	ND
Methidathion (0.02 ppm)	ND
Methyl Chlorpyrifos (0.01 ppm)	ND
Methyl Parathion (0.02 ppm)	ND
Naled (0.02 ppm)	ND
Nemacur (0.02 ppm)	ND
Parathion (0.02 ppm)	ND
Phosdrin (0.02 ppm)	ND
Pirimiphos, Methyl (0.02 ppm)	ND
Thimet (0.02 ppm)	ND

*Predetermined instrumental detection limits

ND - Not Detected, below detection limits

Methodology
(1) Modified Official Methods of Analysis of the Association of Official Analytical Chemists, 15th Edition, 1990, 970.52 -974.22.

I certify that in this official sample of feeding stuff, the amounts of chemical substances that were found are shown above.

SIGNATURE OF CHEMIST	LABORATORY	DATE
		JAN 5 1996

FS-26
3/86

State of Hawaii
DEPARTMENT OF AGRICULTURE
Commodities Branch

FEED ANALYSIS REPORT
Adulteration

1. DATE SAMPLED: August 30, 1995	2. SAMPLE NO.: 35218A
3. HAWAII REGISTRATION NO.: Exempt	
4. LOT SIZE: Bags / Tons	Bulk Tons 17.0
5. BRAND OR PRODUCT NAME: Pineapple Wet Skins & Pulp	6. PRODUCTION CODE

7. NAME AND ADDRESS OF MANUFACTURER (Include Zip Code)

Del Monte Fresh Produce (Hawaii) Inc.
94-1000 Kunia Rd.
Kunia, HI 96759

8. NAME AND ADDRESS OF FEED DEALER OR CONSIGNEE (Include Zip Code)

Sampled at: Kunia

9. RESULTS OF ANALYSIS

Organochlorine Pesticides (1)

Pesticide (Detection Limit *)	Found
Aldrin (0.01 ppm)	ND
Bayleton (0.01 ppm)	ND
Captan (0.02 ppm)	ND
Cis-chlordane (0.02 ppm)	ND
op-DDD (0.04 ppm)	ND
pp-DDD (0.04 ppm)	ND
op-DDE (0.02 ppm)	ND
pp-DDE (0.01 ppm)	ND
op-DDT (0.04 ppm)	ND
pp-DDT (0.04 ppm)	ND
Dicofol (0.02 ppm)	ND
[illegible]in (0.02 ppm)	ND
Endrin (0.04 ppm)	ND
Endosulfan I (0.02 ppm)	ND
Endosulfan II (0.02 ppm)	ND
Endosulfan Sulfate (0.02 ppm)	ND
Heptachlor (0.005 ppm)	ND
Heptachlor Epoxide (0.02 ppm)	ND
Lindane (0.005 ppm)	ND
Methoxychlor (0.02 ppm)	ND
Mirex (0.02 ppm)	ND

Organophosphorous Pesticides (1)

Pesticide (Detection Limit *)	Found
Carbophenothion (0.02 ppm)	ND
Chlorpyrifos (0.02 ppm)	ND
Cygon (0.02 ppm)	ND
DEF (0.02 ppm)	ND
Diazinon (0.01 ppm)	ND
Ethion (0.02 ppm)	ND
Fonofos (0.02 ppm)	ND
Ethoprop (0.02 ppm)	ND
Gardona (0.01 ppm)	ND
Malathion (0.01 ppm)	ND
Methidathion (0.02 ppm)	ND
Methyl Chlorpyrifos (0.01 ppm)	ND
Methyl Parathion (0.02 ppm)	ND
Naled (0.02 ppm)	ND
Nemacur (0.02 ppm)	ND
Parathion (0.02 ppm)	ND
Phosdrin (0.02 ppm)	ND
Pirimiphos, Methyl (0.02 ppm)	ND
Thimet (0.02 ppm)	ND

*Predetermined instrumental detection limits

ND - Not Detected, below detection limits

Methodology
(1) Modified Official Methods of Analysis of the Association of Official Analytical Chemists, 15th Edition, 1990, 970.52 -974.22.

SEP 25 1995

I certify that in this official sample of feeding stuff, the amounts of chemical substances that were found are shown above.

SIGNATURE OF CHEMIST	LABORATORY	DATE
[signature]	Chem Analysis	9/14/95

FS-26
3/86

State of Hawaii
DEPARTMENT OF AGRICULTURE
Commodities Branch

FEED ANALYSIS REPORT

Adulteration

1. DATE SAMPLED	2. SAMPLE NO.
January 31, 1996	36013A
3. HAWAII REGISTRATION NO. Exempt	
4. LOT SIZE: Bags	Tons
Bulk Tons 9	

5. BRAND OR PRODUCT NAME	6. PRODUCTION CODE
Pineapple Wetskins	

7. NAME AND ADDRESS OF MANUFACTURER (Include Zip Code)	8. NAME AND ADDRESS OF FEED DEALER OR CONSIGNEE (Include Zip Code)
Del Monte Corporation 94-1000 Kunia Drive Kunia, HI 96759	Del Monte Corporation 94-1000 Kunia Drive Kunia, HI 96759

9. RESULTS OF ANALYSIS

Organochlorine Pesticides (1)

Pesticide (Detection Limit *)	Found
Aldrin (0.01 ppm)	ND
Bayleton (0.01 ppm)	ND***
Captan (0.02 ppm)	ND
Cis-chlordane (0.02 ppm)	ND
op-DDD (0.04 ppm)	ND
pp-DDD (0.04 ppm)	ND
op-DDE (0.02 ppm)	ND
pp-DDE (0.01 ppm)	ND
op-DDT (0.04 ppm)	ND
pp-DDT (0.04 ppm)	ND
Dicofol (0.02 ppm)	ND
drin (0.02 ppm)	ND
rin (0.04 ppm)	ND
Endosulfan I (0.02 ppm)	ND
Endosulfan II (0.02 ppm)	ND
Endosulfan Sulfate (0.02 ppm)	ND
Heptachlor (0.005 ppm)	ND
Heptachlor Epoxide (0.02 ppm)	ND
Lindane (0.005 ppm)	ND
Methoxychlor (0.02 ppm)	ND
Mirex (0.02 ppm)	ND

Organophosphorous Pesticides (1)

Pesticide (Detection Limit *)	Found
Carbophenothion (0.02 ppm)	ND
Chlorpyrifos (0.02 ppm)	ND
Cygon (0.02 ppm)	ND
DEF (0.02 ppm)	ND
Diazinon (0.01 ppm)	ND
Ethion (0.02 ppm)	ND
Fonofos (0.02 ppm)	ND
Ethoprop (0.02 ppm)	ND
Gardona (0.01 ppm)	ND
Malathion (0.01 ppm)	ND
Methidathion (0.02 ppm)	ND
Methyl Chlorpyrifos (0.01 ppm)	ND
Methyl Parathion (0.02 ppm)	ND
Naled (0.02 ppm)	ND
Nemacur (0.02 ppm)	ND
Parathion (0.02 ppm)	ND
Phosdrin (0.02 ppm)	ND
Pirimiphos, Methyl (0.02 ppm)	ND
Thimet (0.02 ppm)	ND

*Predetermined instrumental detection limits
***Confirmed by two-column GC and GC/Mass Spectrophotometry

ND - Not Detected, below detection limits

Methodology
(1) Modified Official Methods of Analysis of the Association of Official Analytical Chemists, 15th Edition, 1990, 970.52 -974.22.

MAR 7 1996

I certify that in this official sample of feeding stuff, the amounts of chemical substances that were found are shown above.

SIGNATURE OF CHEMIST	LABORATORY	DATE

APPENDIX D

APPENDIX D.

EXECUTIVE SUMMARY

The enclosed report is an academic paper written to fulfill the requirements of a masters of public health at the University of Hawaii. I believe you will find this paper informative, well written, and of benefit to both Del Monte Corporation and the Straub physicians who supervised the pesticide surveillance program.

The first several chapters are a general review of organophosphate pesticides and their mechanisms of toxicity. Additionally, the Del Monte safety program is reviewed and the use of pesticides within the company is explained.

Chapter six summarizes the Del Monte pesticide monitoring data that has been obtained from 1985 until now. Several important conclusions from this data can be ascertained.

1. The laboratory "normal" values for plasma and red blood cell cholinesterase that are used as baseline values have changed over the years and it is likely they will continue to change.

2. It is not practical or medically necessary to re-draw employee blood samples to recalculate baseline values each time the reference laboratory makes minor changes in its "normal" values.

3. The Straub physicians will need to continue closely monitor the laboratory testing methodology and "normal" values to be alert for these changes.

This masters paper has afforded the physicians at Straub clinic an excellent opportunity to carefully review all aspects of the Del Monte pesticide surveillance program. We find that the program is effective, well organized and exceed both state and federal requirements. No evidence of organophosphate poisoning was identified.

CRK/vs6/251

Charles Kelley, MD